Modeled De Facto Reuse and Contaminants of Emerging Concern in Drinking Water Source Waters

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Drinking water source waters are commonly under the influence of treated wastewater discharged upstream of drinking water treatment plant (DWTP) surface water intakes, a situation identified as de facto reuse (DFR). To better understand a DWTP's potential impact from organic contaminants of emerging concern (CECs) of wastewater origin under a range of streamflow conditions, the De Facto Reuse in our Nation's Consumable Supply (DRINCS) model was applied to estimate DFR at 22 surface water DWTPs. Results from a previous study analyzing those surface water intakes for 192 organic CECs with predictions of DFR from DRINCS were compared to evaluate exposure risks obtained by the two approaches.

The DRINCS predicted DFR ranging from "no impact" to 12.8% under mean streamflow; DFR values separated by Strahler stream order are shown in Figure 1, part A, with circles representing DFR at median streamflow and whiskers the 5th and 90th streamflow percentiles. Figure 1, part B, displays the number of quantitative detections for the 175 pharmaceutical and anthropogenic waste indicators (AWIs) at each location, separated by Strahler stream order and ranked by median DFR. Per- and polyfluoroalkyl substances (PFAS) showed less correlation with DFR (wastewater), perhaps due to significant non-wastewater contributors of PFAS upstream of DWTPs (data not shown). Within each stream order, the number of quantitatively detected analytes roughly increases as DFR increases (Figure 1, part B). One notable exception to this trend is the DWTP 1 outlier. Field blank detections resulted in analyte censoring in these samples and therefore fewer reported measurements.

When plotted against the sum of pharmaceuticals and AWI concentrations, larger DFRs are generally correlated with greater concentrations of CECs in the source water (Figure 1, part C). When the DWTP 1 outlier is excluded, the R^2 is 0.52, indicating that as much as 50% of the variation in CEC concentration between DWTPs can be predicted by the DFR. The comparison between DRINCS and the CEC occurrence data demonstrates the utility of using DRINCS as a tool to identify locations of DWTPs for future sampling and treatment technology testing. It also demonstrates the need for DWTP operators to have an understanding of upstream wastewater treatment plants and the DFR at their location to estimate potential CEC loads in their source water.

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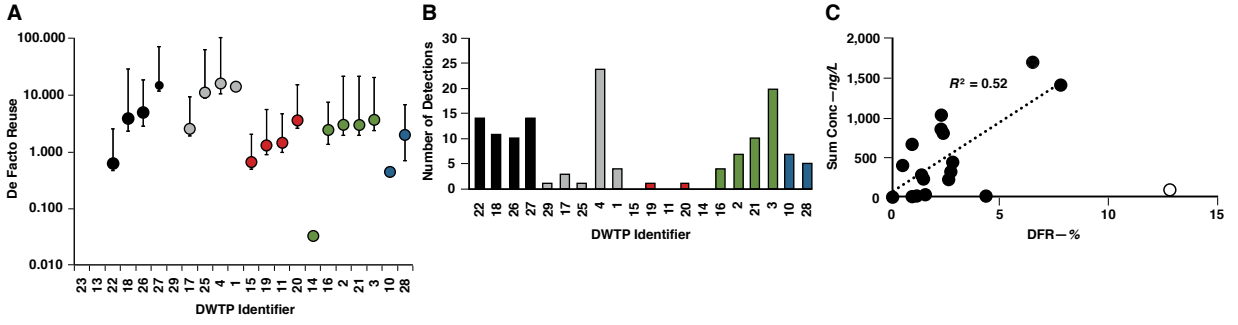
FIGURE 1 DFR (A), quantitative detections (B), and correlation between DFR and sum of the pharmaceutical and anthropogenic waste indicator concentration (C)



Conc—concentration, DFR—de facto reuse, DWTP—drinking water treatment plant